

## CLAIMS

We claim:

1. A method for simulating structural responses of a rubber-like material in finite element analysis, the method comprising:

generating a plurality of stress function  $f(\lambda)$  values by summing up a series of stresses associated with a set of predefined stretch ratios, wherein the series of stresses are defined by a set of stress-strain curves for the rubber-like material under a uniaxial loading condition;

storing the plurality of stress function  $f(\lambda)$  values into a stress function lookup table;

for each integration point of each element with the rubber-like material at each time step,

solving eigensolution for a deformation gradient tensor to obtain a set of principal stretches;

calculating stresses in principal directions from the stress function lookup table via a table lookup scheme using the set of principal stretches; and

transforming the stresses into global coordinate system.

2. The method as recited in claim 1, wherein the finite element analysis is based on explicit finite element analysis solution method.

3. The method as recited in claim 1, wherein the finite element analysis is based on implicit finite element analysis solution method.

4. The method as recited in claim 1, wherein the table lookup scheme is based on interpolation from the stress function table.

5. A finite element analysis software product to be executable in a computing device for simulating structural responses of a rubber-like material, the software product comprising:

program code for generating a plurality of stress function  $f(\lambda)$  values by summing up a series of stresses associated with a set of predefined stretch ratios, wherein the series of stresses are defined by a set of stress-strain curves for the rubber-like material under a uniaxial loading condition;

program code for storing the plurality of stress function  $f(\lambda)$  values into a stress function lookup table;

for each integration point of each element with the rubber-like material at each time step,

program code for solving eigensolution for a deformation gradient tensor to obtain a set of principal stretches;

program code for calculating stresses in principal directions from the stress function lookup table via a table lookup scheme using the set of principal stretches; and

program code for transforming the stresses into global coordinate system.

6. The finite element analysis software product as recited in claim 5, wherein the finite element analysis is based on explicit finite element analysis solution method.

7. The finite element analysis software product as recited in claim 5, wherein the finite element analysis is based on implicit finite element analysis solution method.

8. The finite element analysis software product as recited in claim 5, wherein the table lookup scheme is based on interpolation from the stress function table.

9. A system for simulating structural responses of a rubber-like material in finite element analysis, the system comprising:

means for generating a plurality of stress function  $f(\lambda)$  values by summing up a series of stresses associated with a set of predefined stretch

ratios, wherein the series of stresses are defined by a set of stress-strain curves for the rubber-like material under a uniaxial loading condition;

means for storing the plurality of stress function  $f(\lambda)$  values into a stress function lookup table;

for each integration point of each element with the rubber-like material at each time step,

means for solving eigensolution for a deformation gradient tensor to obtain a set of principal stretches;

means for calculating stresses in principal directions from the stress function lookup table via a table lookup scheme using the set of principal stretches; and

means for transforming the stresses into global coordinate system.

10. The system as recited in claim 9, wherein the finite element analysis is based on explicit finite element analysis solution method.

11. The system as recited in claim 9, wherein the finite element analysis is based on implicit finite element analysis solution method.

12. The system as recited in claim 9, wherein the table lookup scheme is based on interpolation from the stress function table.